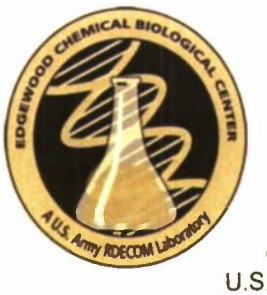

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RECOVERY OF VIRUS SAMPLES FROM VARIOUS SURFACES WITH THE INTEGRATED VIRUS DETECTION SYSTEM

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14. ABSTRACT
Viruses are known to survive in environmental settings over various time periods. This study will show that certain viruses survive for a 24 h period, and certain viruses do not survive, depending on the substrate with which the viruses are in contact.

15. SUBJECT TERMS

Virus detection	Differential mobility analyzer	Condensation particle counter
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Medical research	Virus recovery	

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PREFACE

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RECOVERY OF VIRUS SAMPLES FROM VARIOUS SURFACES WITH THE INTEGRATED VIRUS DETECTION SYSTEM

1. INTRODUCTION

Viruses are known to survive in environmental settings [1, 2, 3] over various time periods. Certain viruses survive for a 24 h period, and certain viruses do not survive that long, depending on the substrate with which the viruses are in contact. This report will examine the recovery of virus samples from various surfaces. The viruses were placed on several surfaces and allowed to sit overnight. The sample areas were swabbed with a buffer solution and tested after 24 h.

2. IVDS DESCRIPTION

The virus recovery samples were analyzed using the Integrated Virus Detector System (IVDS). The detection stage of the IVDS consists of an electrospray unit to inject samples into the detector, a Differential Mobility Analyzer (DMA) and a Condensate Particle Counter (CPC), shown in Figure 1.

The electrospray unit subjects a conductive liquid to a strong electric field. The field produces a cone that emits a fine jet that then breaks up into small droplets and forms a fine plume. To eliminate the possibility of the breakdown (corona discharge) of the air in the plume, as caused by the high electric field, the spray tip is surrounded by a flow of CO_2, which will prevent corona discharge.

The DMA separates particles by their electrical mobility in air. The sample stream flows through a gap between a rod and a cylinder with an electrical potential between the two. Particle mobility, which is related to size and charge, will either pass particles through the DMA or impinge on the walls. With singly charged particles, which are generated by the electrospray, the mobility becomes a direct measure of the particle size.

In the CPC, the sample particles flow in tandem with a saturated working fluid of butanol. The nanosized particles initiate the condensation of the butanol, and the stream is then cooled. A standard optical counter can then count the butanol-condensed particles, and the results are displayed via the supplied software.

A complete description of the IVDS system, including the detector, can be found in several previous references [4, 5].

3. EXPERIMENTAL SETUP

Several viruses, MS2, a bacteriophage, and tomato bushy stunt virus (TBSV) were pipetted onto several surfaces overnight. The samples dried out in the 24 h time frame and were only visible due to the area being marked prior to samples being placed on the surfaces.

The sample volume for each application was 50 µl of the baseline sample. The baseline samples, an MS2 (sample Live LB, dilute 1:100 20 mM ammonium acetate) and MS2 plus TBSV were analyzed with the IVDS and are shown in Figures 2 and 3. The peak for the MS2 bacteriophage is shown at 24.1 nm, and the peak for TBSV is shown at 32.2 nm. At the end of the 24 h period, 50 µl of a 20 mM ammonium acetate solution was pipetted onto the virus spot and worked with a sterile cotton swab. The swab was placed into a closed tube with 500 µl of the 20 mM ammonium acetate solution, capped, and vortexed for 10-20 s. The sample was then analyzed with the IVDS.

Samples were applied to glass (microscope slide), stainless steel (balance plate), plastic (computer top-smooth), ceramic (stir plate surface at ambient temperature), and lacquered wood (meter stick). All sample areas were cleaned before application. The table shows the sample application.

4. RESULTS

MS2 was recovered and detected, at reduced levels, from the stainless steel (Figure 4), plastic (Figure 5), ceramic (Figure 6), and lacquered wood (Figure 7). The glass applications (Figure 8) were not conclusive for MS2 recovery and detection. The glass analysis with the IVDS had a very small peak at 24 nm, the size of MS2 measured with the IVDS. This peak was not distinguishable from the background and could not be labeled a positive detection. The other samples had distinguishable peaks above background.

TBSV was recovered and detected, at reduced levels, from the stainless steel (Figure 9) and glass sample (Figure 10). The IVDS showed distinguishable peaks above background

5. CONCLUSIONS

The virus samples, MS2 and TBSV, were applied to several surfaces and left at ambient temperature overnight in the laboratory. The samples were collected with cotton swabs and analyzed with the IVDS. The virus samples were recovered from all surfaces except for the MS2 application to the glass slide.

Figure 1. IVDS analyzer

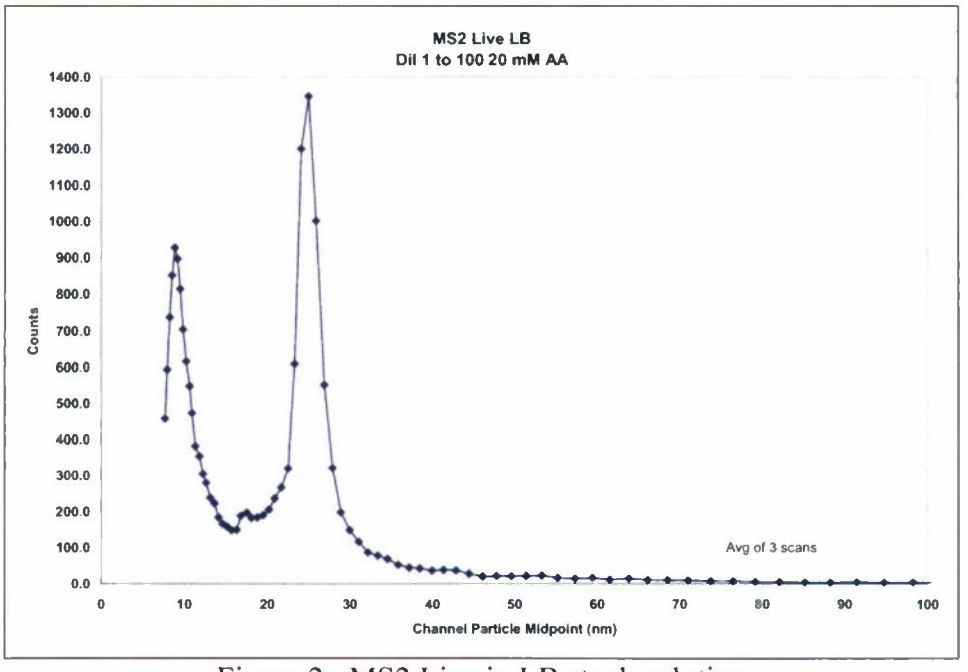

Figure 2. MS2 Live in LB stock solution

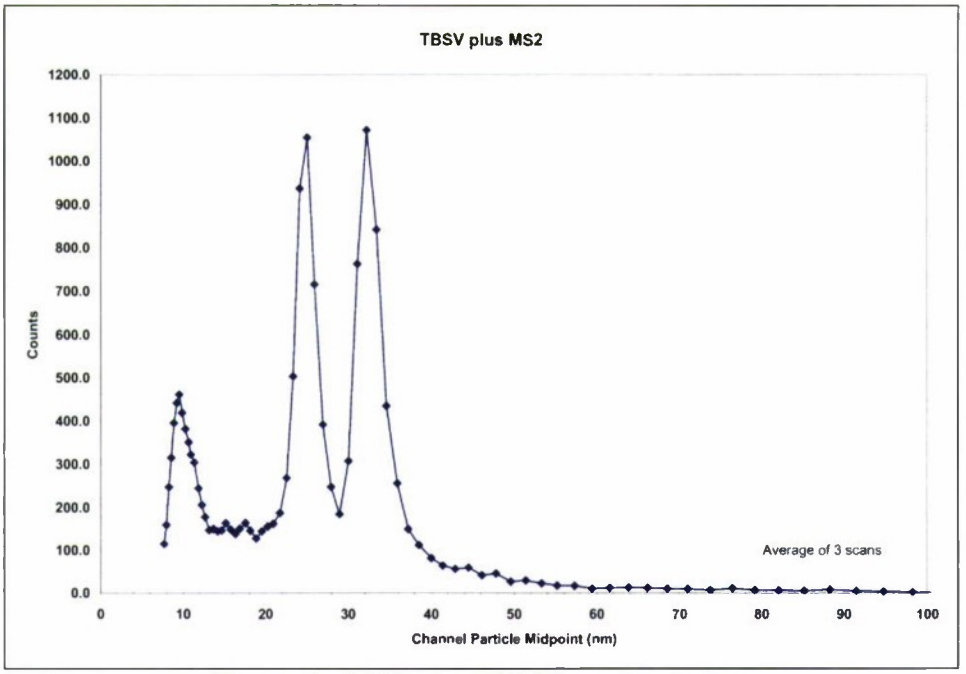

Figure 3. MS2 plus TBSV stock solution

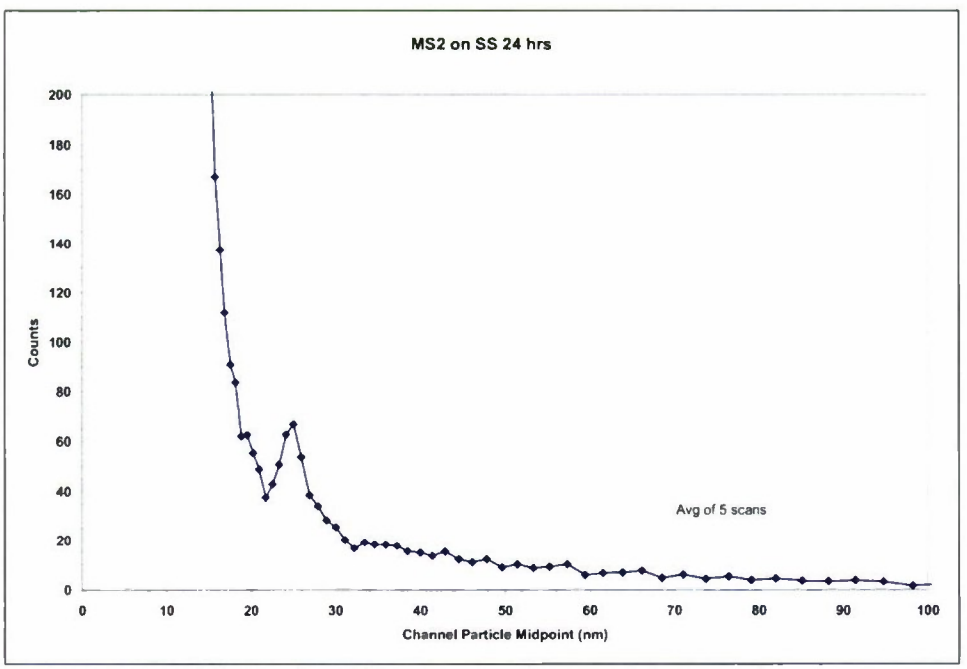

Figure 4. MS2 recovery from stainless steel

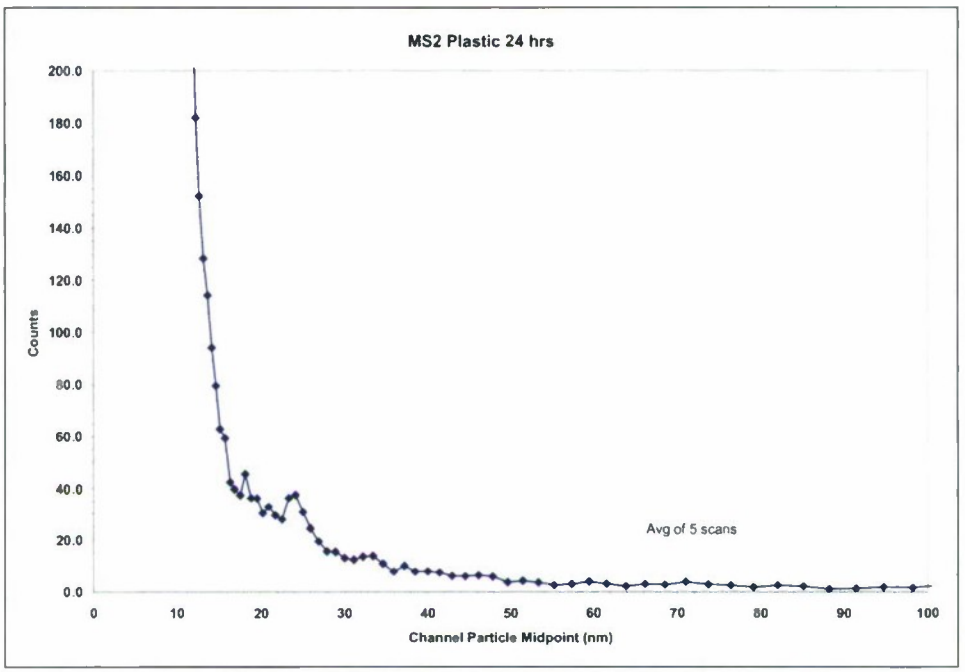

Figure 5. MS2 recovery from plastic

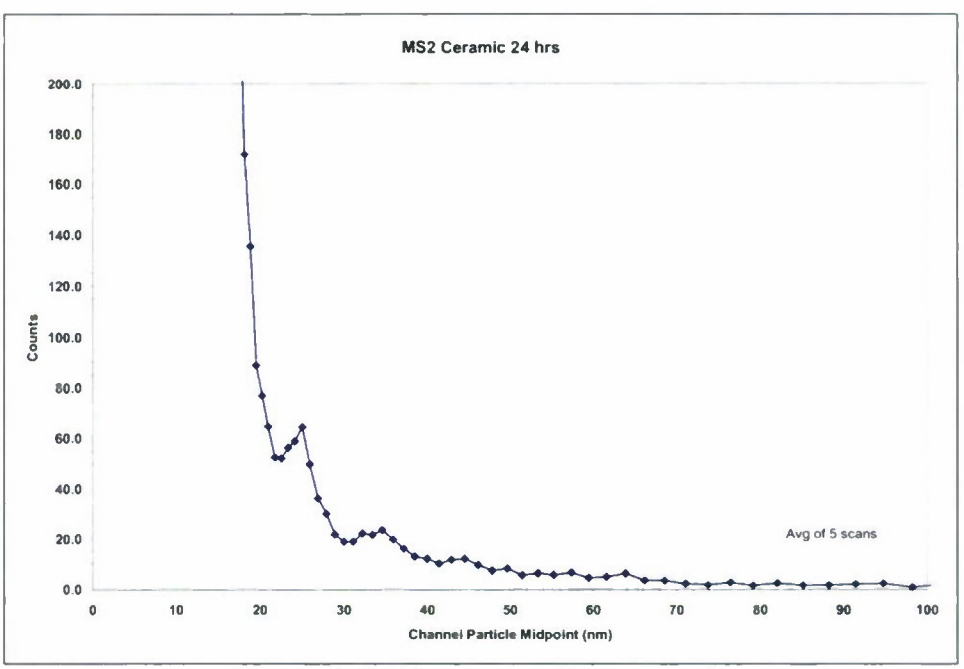

Figure 6. MS2 recovery from ceramic

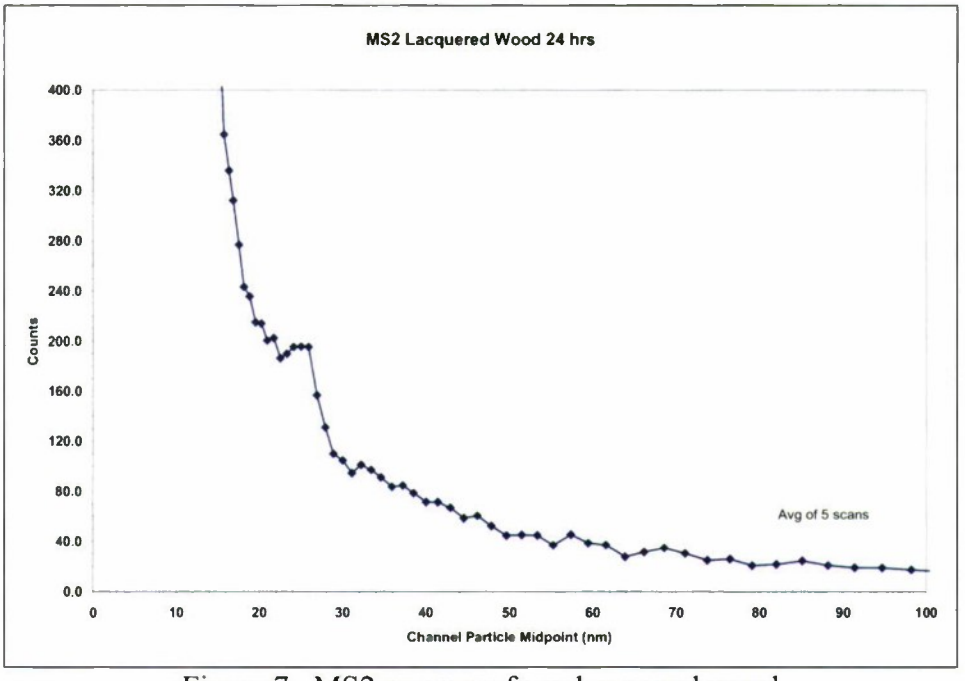

Figure 7. MS2 recovery from lacquered wood

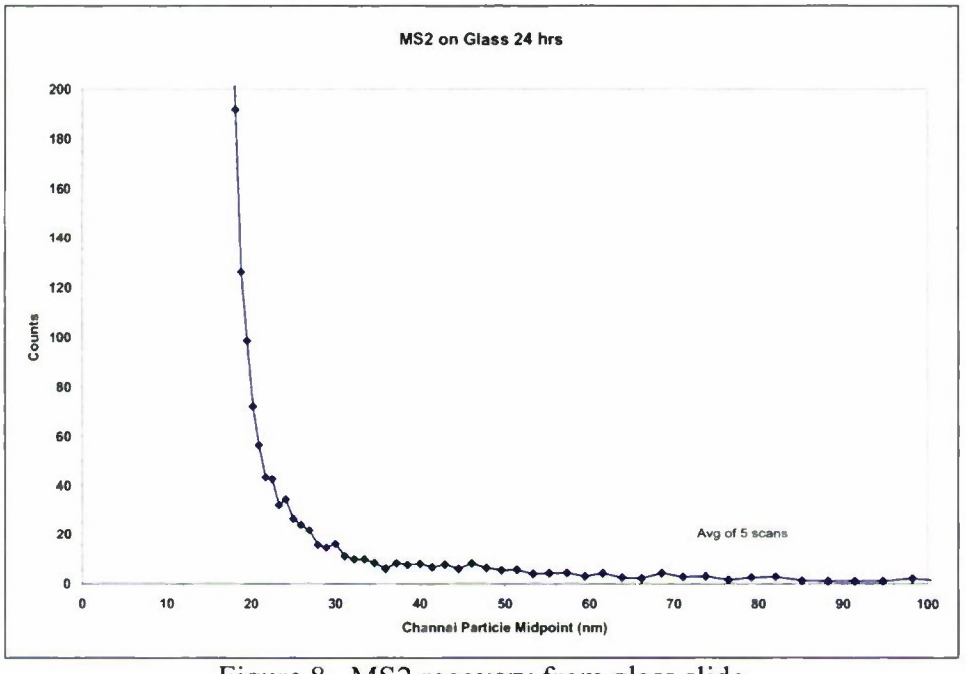

Figure 8. MS2 recovery from glass slide

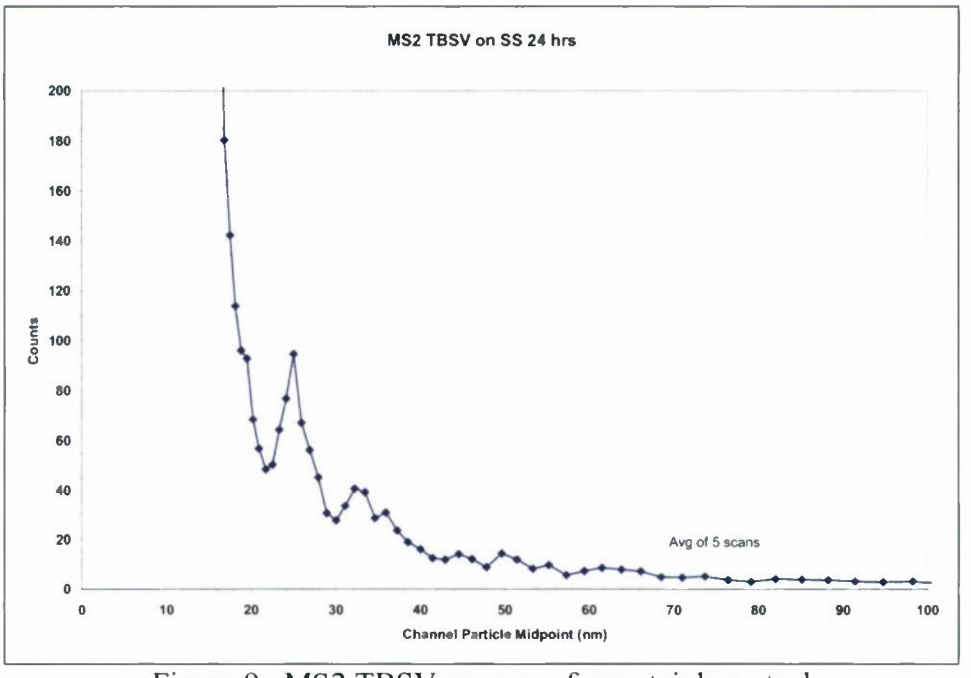

Figure 9. MS2 TBSV reeovery from stainless steel

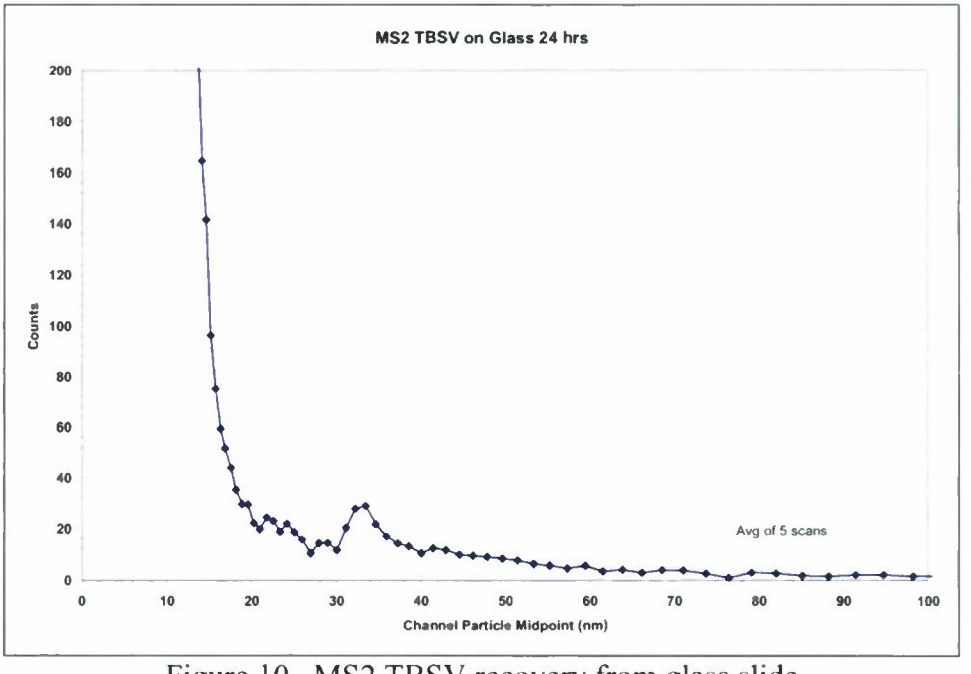

Figure 10. MS2 TBSV recovery from glass slide

Table. Virus application to surfaces

Virus sample	Surfaee	IVDS deteetion	
		MS2	TBSV
MS2 (Live in LB)	Glass	Not eonelusive	n.a.
MS2 (Live in LB)	Stainless steel	Yes	n.a.
MS2 (Live in LB)	Plastie	Yes	n.a.
MS2 (Live in LB)	Ceramie	Yes	n.a.
MS2 (Live in LB)	Laequered wood	Yes	n.a.
MS2 plus TBSV	Glass	Not eonelusive	Yes
MS2 plus TBSV	Stainless steel	Yes	Yes

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